Asset Allocation with Machine Learning & Parameter Uncertainty

Supervisors:

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We are looking for PhD candidates with an excellent understanding of finance and strong mathematical skills, perhaps gained via an earlier degree in mathematics, natural sciences or engineering.

The mean-variance portfolio optimization framework of Markowitz (1952) is a highly popular portfolio optimization tool that has been widely used by academics and in the financial services industry. The Markowitz mean-variance portfolio framework is optimal only when asset returns follow a Normal distribution and the input parameters (mean returns and covariance matrix) are known with certainty. However, the prediction of mean returns and covariances can be very challenging and the use of sample (historical) estimates in mean-variance optimization is often subject to significant estimation risk. Furthermore, asset returns do not follow a Normal distribution in practice. As a direct consequence, the mean-variance portfolio construction process as proposed by Markowitz (1952) can be an error maximizer by generating solutions that are very far away from being optimal out-of-sample (when input parameters are uncertain) and this phenomenon has been well-documented in the literature; see, for instance, Board and Sutcliffe (1994), Ziemba and Mulvey (1998), Levy and Roll (2010), Levy and Levy (2014) and Platanakis, Sutcliffe and Ye (2021).

The main target of this project is to develop robust portfolio optimization techniques that perform well out-of-sample via the novel implementation of machine learning techniques (e.g. supervised, unsupervised, semi-supervised and reinforcement learning) in conjunction with sophisticated portfolio optimization methods (e.g. shrinkage techniques) and advanced statistical methods (e.g. Bayesian inference).

References:

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